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\[ \beta - \gamma \text{ Circular Polarization Correlation in } \text{Au}^{198} \text{ and Co}^{68} \]

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The \( \beta - \gamma \) circular polarization correlation provides a valuable tool for the study of the beta-decay interaction.\(^1\)\(^2\) Recently a large interference term due to the presence of \( S \) and \( T \) or \( V \) and \( A \) interaction has been found in the allowed \( J-J \) transition of \( \text{Sc}^{46} \). We report here studies of the \( J-J \) transitions in \( \text{Au}^{198} \) and \( \text{Co}^{68} \). Both nuclei exhibit a simple \( \beta - \gamma \) cascade and are, therefore, quite suitable for a circular polarization correlation experiment. The spin pattern for both decays is \( 2(\beta)2(\gamma)0 \). Preliminary results in \( \text{Au}^{198} \) have been reported earlier.\(^1\) In the meantime Frauenfelder \( \text{et al.} \)\(^5\) and de Waard \( \text{et al.} \)\(^5\) have measured the electron polarization of \( \text{Au}^{198} \). Since the combination of the electron polarization data with our circular polarization correlation result can yield interesting information on the beta-decay coupling, improvement of our preliminary data seemed desirable. The anisotropy in the electron emission of \( \text{Co}^{68} \) has been studied by Ambler \( \text{et al.} \)\(^6\) and Postma \( \text{et al.} \)\(^7\) using the nuclear alignment technique. Ambler \( \text{et al.} \) have pointed out that their result if explained by an \( S \), \( T \) interaction leads to a different ratio of Fermi to Gamow-Teller matrix elements than that given by Griffin and Wheatley\(^8\) from the study of the anisotropy of \( \gamma \) rays from aligned \( \text{Co}^{68} \) nuclei. In the present experiment a different sign of the correlation coefficient is expected to appear.

The circular polarization of the \( \gamma \) rays in coincidence with the \( \beta \) particles was measured by using the method described in reference 1. Sources of 50–150 microcuries strength were deposited on a 0.8-mg/cm\(^2\) Mylar backing. Single and coincidence counts were recorded under similar experimental conditions as described in reference 3. The relative difference in coincidence counting rate for opposite magnetic field directions is found to be, in the case of \( \text{Au}^{198} \), \( \delta = (+0.75\pm0.12)\% \), which leads to a value of \( A = +0.52\pm0.09 \) for the asymmetry parameter \( A \) defined in reference 1. This result is in good agreement with our earlier value. For \( \text{Co}^{68} \) the result is \( \delta = (0.27\pm0.13)\% \) and \( A = -0.14\pm0.07 \).

Auer\(^6\) is a first forbidden transition. A rough analysis of our results with the help of the formulas by Alder, Stech, and Winther\(^2\) has been carried out. Combination of the present results with the small longitudinal electron polarization found by Frauenfelder \( \text{et al.} \)\(^5\) and de Waard \( \text{et al.} \)\(^5\) would favor parity conservation in Fermi transitions.\(^8\)

The result on \( \text{Co}^{68} \) is in agreement with the values corresponding to \( A \approx -0.20 \) and \( A = -0.22\pm0.03 \) derived from the measurements on aligned nuclei. The theoretical value for a pure Gamow-Teller transition is \( A = -0.166 \). If we make use of our result on \( \text{Sc}^{46} \) for the magnitude of the \( S, T \) (or \( V, A \)) interference term it seems likely that the Fermi matrix element is smaller than about \( 1/4 \) of the Gamow-Teller matrix element. This is in slight disagreement with the ratio 1/2.8 found by Griffin and Wheatley.\(^8\)

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\( \text{Ca}^{198} \) is the daughter of \( \text{Co}^{68} \).

\(* \) On leave of absence from the Institute for Nuclear Research, Amsterdam, and the Technical University, Delft, Netherlands.


\( 2 \) Alder, Stech, and Winther, Phys. Rev. 107, 728 (1955); Reprint, University of Illinois (unpublished).

\( 3 \) F. Boehm and A. H. Wapstra, Phys. Rev. 107, 1202 (1957).


\( 5 \) de Waard (private communication).


\( 7 \) Postma, Huiskamp, Miedema, Steenland, Tolhoek, and Gorter, Physica 23, 259 (1957).


\( * * * \) Note added in proof—New measurements on \( \text{Au}^{198} \) by P. E. Cavanagh \( \text{et al.} \) (private communication) and C. S. Wu \( \text{et al.} \) (private communication) indicate, however, that the longitudinal electron polarization is nearly \( -\gamma/e \) in this nucleus. In that case our experiment agrees well with the two-component neutrino theory and indicates a maximum amount of interference between different \( T \) (or \( A \)) and \( S \) (or \( V \)) matrix elements.

Spin and Magnetic Moment of P\(^{22}\) by the Electron Nuclear Double-Resonance Technique

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The spin and magnetic moment of 14-day P\(^{22}\) was determined by the electron nuclear double resonance (ENDOR) technique. The P\(^{22}\) obtained from Oak Ridge was diffused\(^2\) into high-resistivity silicon plates having a total volume of 0.25 cm\(^3\).

The paramagnetic resonance signal observed at \( \sim9000 \text{ Mc/sec} \) and 1.2\(^\circ\)K is shown in Fig. 1. It corre-